Science & Technical Support Section's
SciFYI
King County
Department of Natural Resources and Parks
Water and Land Resources Division
A science section digest of current environmental issues in King County
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What's happening with kokanee in Lake Sammamish?

by: Hans Berge and David Lantz

Male and female adult kokanee spawning in Ebright Creek, 2012. Photo: Roger Tabor, USFWS.

What are kokanee?

Kokanee salmon (Oncorhynchus nerka) are a non-migratory life history form of sockeye salmon native to the Pacific Northwest and Canada. Like other Pacific salmon, kokanee spawn during the autumn and their progeny hatch the following winter and spring. After hatching, the newly emerged kokanee fry immediately migrate downstream to a nursery lake. In the lake the kokanee feed primarily on zooplankton (Daphnia are their preferred prey) and insects and avoid being eaten by predators such as cutthroat trout. They spend between three and five years in their nursery lake before ascending into their natal streams once more to spawn. Unlike anadromous salmon, kokanee spend their entire lives in freshwater.

What is their history?

Two lakes in the Puget Sound region still have known populations of native kokanee: Lake Whatcom and Lake Sammamish. Historically, spawning kokanee in tributaries of Lake Sammamish numbered in the tens of thousands and spawned in more than a dozen streams. They were an important source of food for Native Americans and a very popular recreational game fish.

(Continued on page 2)

FIGURE 1.
Map of Lake Sammamish and four main tributaries that support kokanee spawning.

(Continued from page 1)

Declining returns during the 1980s and 1990s led to a complete closure of the recreational fishery on Lake Sammamish and prompted concern from citizens and agencies with jurisdiction along the lake. By the late 1990's, there were only four tributaries of Lake Sammamish that supported spawning kokanee (Figure 1), and since 1996, kokanee returns in Lake Sammamish tributaries have been highly variable (Figure 2).

This continued population decline prompted concern about kokanee survival and led to the filing of listing petitions (in 2000 and 2007) with the U.S. Fish and Wildlife Service (USFWS) to give Lake Sammamish kokanee protection under the Endangered Species Act. Ultimately, both petitions were rejected with the finding that the Lake Sammamish kokanee population was not a listable entity under the definitions in the USFWS Distinct Population Segment Policy.

Recovery efforts

In 2007 a local collaboration formed to focus on kokanee conservation in Lake Sammamish. The Kokanee Work Group (KWG) is chaired and coordinated by King County Department of Natural Resources and Parks and includes representation from each local government along the lake, several non-governmental conservation groups, the Washington Department of Fish and Wildlife (WDFW), the Snoqualmie Tribe, the USFWS, and watershed residents.

The goal of the KWG is to "prevent the extinction and improve the health of the native kokanee population such that it is viable and self-sustaining, and then supports fishery opportunities".

The first task of the KWG was to identify limiting factors and to prioritize immediate steps to address stressors and improve conditions for kokanee, and provide a forum to identify and help advance implementation of actions that need to be taken immediately to ensure kokanee persist in perpetuity.

FIGURE 2.
Area-Under-the-Curve escapement estimate for kokanee in four tributaries of Lake Sammamish (broodyears 1996-2012).

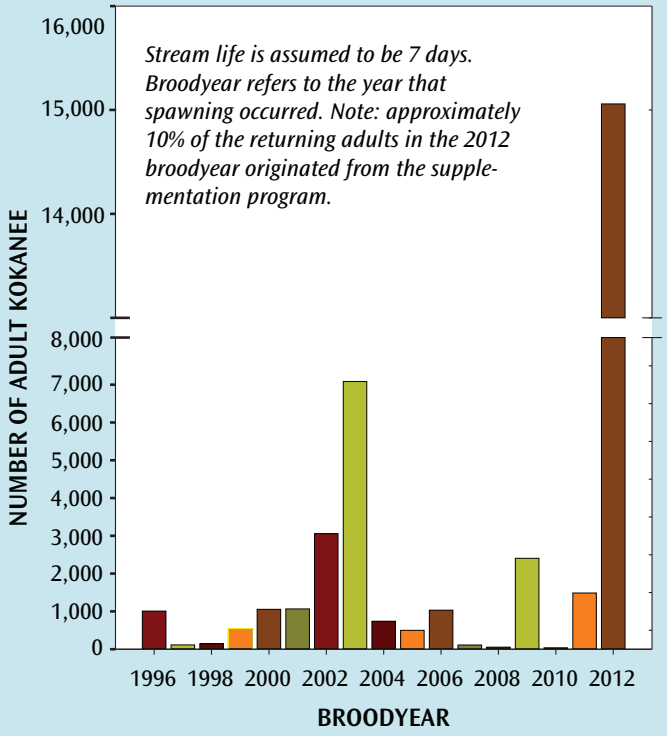
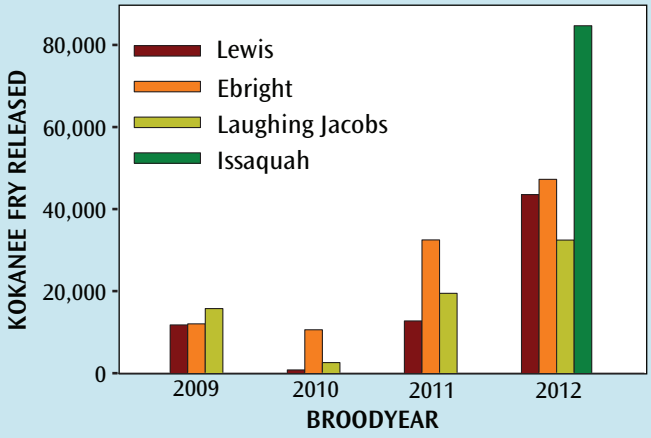
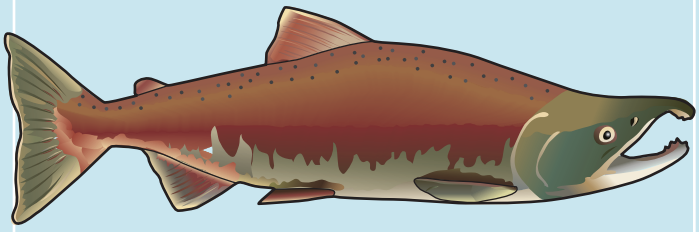


FIGURE 3.
Number of kokanee fry released from the Lake Sammamish kokanee supplementation program into natal streams for broodyears 2009 through 2012.





LAKE SAMMAMISH KOKANEE

One major finding of the limiting factors report was the immediate need for an emergency supplementation effort to improve egg-to-fry survival synchronously with habitat restoration. In 2009, with the support of funds from the USFWS, WDFW, King County, the USFWS began collecting kokanee adults from the spawning grounds around Lake Sammamish and spawned them artificially at the Issaquah hatchery to augment and help sustain the natural spawning population.

Success of the planned 12-year supplementation program is measured by monitoring the abundance of spawners, phenotypic characteristics (sex ratio, age, size at age, proportion of hatchery fish in the broodstock, etc.) and genetic diversity. All hatchery reared kokanee are released with a unique thermal mark and adults from the spawning grounds and the broodstock are dissected for both otoliths and genetic tissues, providing an opportunity to compare both groups over time.

In the first year of the program, 101 adult kokanee (39 males and 62 females) were removed from the natural spawning grounds and spawned at the Issaquah Hatchery. Fertilized embryos were transported to two WDFW hatchery facilities for incubation to minimize risk.

After successfully hatching kokanee fry at the Landsburg and Chambers Creek hatcheries, more than 35,000 fry were released back to their natal tributaries of Lake Sammamish, adding to an estimated 150,000 natural origin fry entering Lake Sammamish in the spring of 2010. Since that first year, the supplementation program has followed the strength of the returns very closely (Figure 2). The largest production year was 2012 with more than 200,000 kokanee fry released into Ebright, Laughing Jacobs, and Lewis creeks, as well as an initial reintroduction of kokanee into Issaquah Creek (Figure 3).

The supplementation program in Lake Sammamish is unique in several ways. First, the program is designed to be temporary (12 years) and to complement ongoing restoration projects. For example, in 2013, kokanee were reintroduced in Issaquah Creek with the intent that fish passage will be provided when they return in 2016.

The novel techniques used in this program, such as incubating them on natal water sources using recirculating incubators, are tailored to improve the success of supplementation and reintroductions throughout the basin as stream habitat conditions improve.

In 2008-2010, favorable temperature and oxygen concentrations in Lake Sammamish, reduced predation from hatchery coho, favorable streamflow during incubation, and three year old recruits from the first year of the supplementation program all contributed to the largest return of kokanee observed since at least 1996 (Figure 2).

While approximately 10 percent of the total return in 2012 came from the hatchery, the real story is that 90 percent of the return originated from the natural spawning grounds. This resilience in the population suggests that there is potential for kokanee to thrive once again in Lake Sammamish if we continue to restore and reconnect extant habitat and do what we can to improve survival at each life stage.

While successful hatchery intervention is a necessary step to recover kokanee, the ultimate success of the KWG will be measured by having a population of kokanee that can support sustainable harvest independent of a hatchery program. The only way this will be possible over time is through habitat protection and restoration.

In 2008, the KWG received a grant from the King Conservation District to identify restoration actions that will benefit chinook and kokanee salmon in Lake Sammamish. These projects primarily focus on improving instream habitats, removing artificial barriers, and restoration of tributary deltas in Lake Sammamish.

Since that time, projects to benefit kokanee have been completed or are under way in Ebright (2012), Issaquah (2013) and Lewis (2010; 2014) creeks. This includes a privately-funded culvert replacement project completed in summer 2012 that approximately tripled the amount of spawning area for kokanee in Ebright Creek.

Looking ahead, King County Parks is developing a project to replace a culvert under the East Lake Sammamish Trail and thus help ensure unfettered access for kokanee to currently unused spawning area on Zaccuse Creek in Sammamish.

Conclusions

Native kokanee salmon in Lake Sammamish once provided an important fishery for harvest. With continued restoration and protection of kokanee to improve productivity, diversity, distribution, and abundance, there may be opportunities for harvest of kokanee again. The return in 2012 suggests that kokanee are resilient and can thrive in Lake Sammamish, and the focus of the KWG is to implement habitat restoration and protection actions throughout the basin to buffer against the effects of anthropogenic and natural stressors such as climate change.

For more information on kokanee in Lake Sammamish, please see the King County kokanee page: http://www.kingcounty.gov/environment/animalsAndPlants/salmon-and-trout/kokanee.aspx.

Contributors to King County's SciFYI

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Daniel Lantz

Daniel Lantz has worked as an Environmental Scientist in the Science and Technical Support section within King County's, Water and Land Resources Division since 2010. His primary focus is working on salmon recovery throughout King County, specifically Lake Sammamish kokanee, Lake Washington chinook, and various restoration monitoring projects. Before coming to King County, Daniel worked for over 11 years with the U.S. Fish and Wildlife Service as a fish biologist, in northern California and Washington, on a variety of fisheries projects, such as bull trout habitat selection, juvenile chinook salmon habitat selection, restoration monitoring, large river habitat surveys, culvert surveys, and urban stream classification.

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